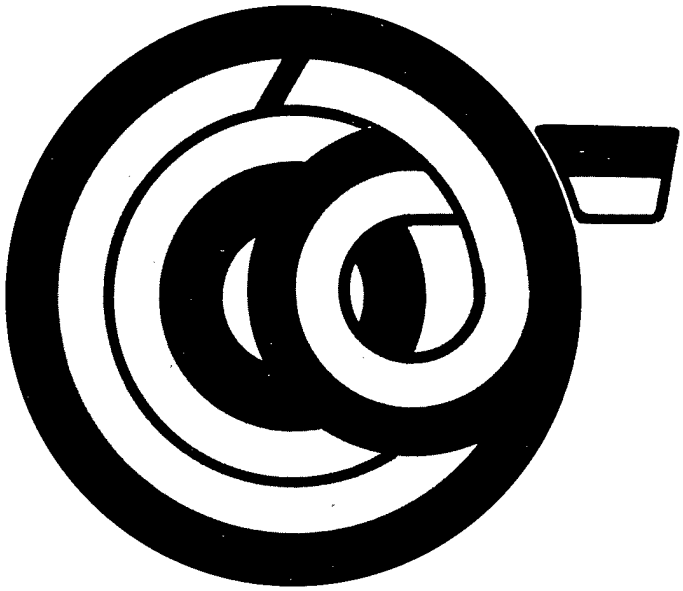
FINAL SUBMISSION

IOWA ARMY AMMUNITION PLANT
BURLINGTON, IOWA



ENERGY
ENGINEERING ANALYSIS

EXECUTIVE SUMMARY

Prepared for

The Department of the Army
Omaha District
Corps of Engineers
Contract No. DACA45-80-C-0090

By

Sanders & Thomas, Inc.
An STV Engineers Professional Firm
Consulting Engineers .

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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May 10, 1983

U.S. Army Corps of Engineers
Omaha District
6014 U.S. Post Office and Court House
Omaha, NE 68102

Attention: MROED-MC

Reference: Energy Engineering Analysis
Iowa Army Ammunition Plant
Burlington, Iowa

Subject: Energy Engineering Analysis - Final Submission

Contract No.: DACA45-80-C-0090

Our Project No.: 05-4660

Gentlemen:

This letter transmits the Final Submission of the Energy Engineering Analysis for the Iowa Army Ammunition Plant, Burlington, Iowa. The Analysis presents energy conservation projects that will enable the plant to meet energy consumption reduction goals, as specified in the Army Facilities Energy Plan.

The Analysis consists of nine components:

- Executive Summary
- Technical Report
- Appendix I: Master Building List
- Appendix II: Energy Conservation Calculations Data
- Appendix III: Energy Conservation Measures Summaries
- Appendix III: Energy Conservation Measures
- Project Programming Documents
- Increment F Study
- Increment F Computer Output

All comments have been reviewed and incorporated in the report, as appropriate.

This Energy Engineering Analysis is a valuable data base that can be used for the development of additional projects as Army goals are revised and other energy conservation projects become viable.

The assistance that was provided by plant and COE personnel proved invaluable in completing this assignment. We appreciate their cooperation and hospitality.

Thank you for this opportunity to be of service.

Very truly yours,

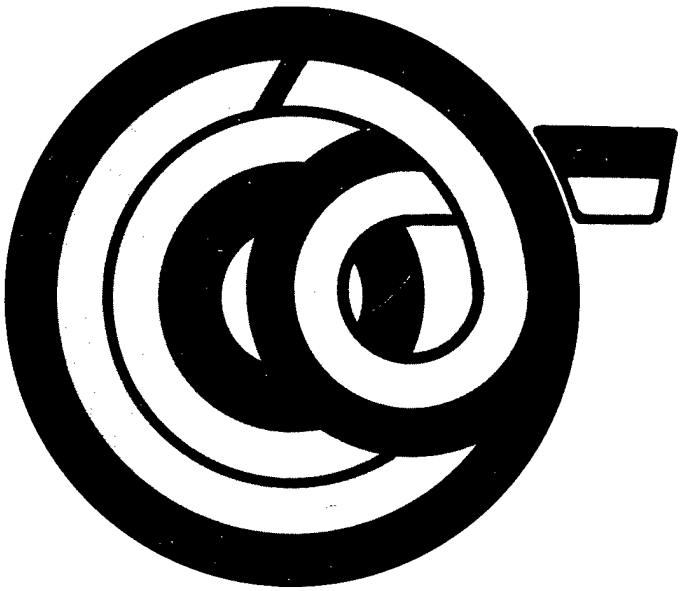
SANDERS & THOMAS, INC.

David M. Jonik, P.E.
Project Manager

DMJ:bg

FINAL SUBMISSION

IOWA ARMY AMMUNITION PLANT
BURLINGTON, IOWA



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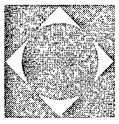

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PROJECT ABSTRACT

ENERGY ENGINEERING ANALYSIS
IOWA ARMY AMMUNITION PLANT

This analysis is undertaken to assist the Iowa Army Ammunition Plant (IAAP) in meeting the goals established by the Army Facilities Energy Plan in effect at the time of our contract to reduce energy consumption by 25 percent by 1985.

Projects selected for standby status implementation as a result of this analysis will enable IAAP to achieve a reduction in energy consumption of 83,000 MBTU's per year. The total cost of implementing these standby status projects is approximately $2.9 million. This energy savings, when combined with energy reductions of approximately 790,000 MBTU's resulting from IAAP energy conservation efforts through 1983, will enable IAAP to achieve the 1985 goal.

USE OF THE REPORT

This Energy Engineering Analysis consists of the main report, three appendices, and a summary of annual energy consumption on a "per-building" basis. The main report identifies the purpose of the study, describes the existing and anticipated energy use trends, and defines and summarizes specific energy conservation projects recommended to achieve the goals stated in the Army Facilities Energy Plan. Appendices I, II and III, and the Annual Energy Consumption Summary include building information, weather data, cost data, and detailed computer-generated and manual calculations for each individual project.

The analysis will enable ammunition plant personnel to identify energy conservation measures and meet Army energy reduction goals.

The report includes:

- Energy consumption by fuel type
- Energy consumption trends
- ECAM projects
- Other potential projects
- Quick-fix management form
- Description of analyzed buildings

In addition, the Analysis is a detailed data base consisting of:

- An analysis of building energy use
- Energy Conservation Measures applied to each analyzed building to be improved
- A set of marked-up prints from the survey indicating the conditions when surveyed

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EXECUTIVE SUMMARY

1.1 PROJECT REQUIREMENT

This engineering analysis is undertaken in order to develop a systematic program of projects that will lead to energy consumption reductions at the Iowa Army Ammunition Plant (IAAP) without compromising the mission of the plant, and in compliance with all applicable environmental and Occupational Safety and Health Administration regulations. Reduced energy consumption is a stated goal of the Army Facilities Energy Plan.

The projects included in this analysis are grouped into five increments: A - Energy Conservation and Management Program (ECAM) Projects for Buildings and Processes, B - ECAM Projects for Utilities and Energy Distribution Systems, E - Central Boiler System Projects, F - Energy Saving Modifications within the Facilities Engineer's Funding Control, and G - Minor Construction, Maintenance, and Repair Projects not ECAM qualified.

2.1 PLANT DESCRIPTION

IAAP is located in Southeastern Iowa 10 miles west of the city of Burlington. IAAP is comprised of 19,146 acres of predominantly level terrain at 525 to 725 feet above sea level. IAAP is contractor-operated by Mason and Hanger-Silas Mason, Inc. Figure 1: Iowa Army Ammunition Plant Location Map, shows the location of the plant. Figure 2: Iowa Army Ammunition Plant General Site Map, shows a general site map of the plant.

The Mason & Hanger-Silas Mason Co., Inc. is the operating contractor designated to carry out the plant's mission to produce a variety of warheads, projectiles, demolition blocks, detonators, mine fuzes, igniters and cartridges.

3.1 ARMY FACILITIES ENERGY PLAN

The Army Facilities Energy Plan sets short and long range energy goals for the Army and provides policy and planning guidance for the development of detailed facility energy plans. The Army's energy goals in effect at the time of our scope of work, compared to present goals, are as shown in Table 1: Comparison of Army Facilities Energy Plan Goals.

The program recommended in this EEA report is consistent with revised Army Facilities Energy Plan goals as stated in the plan's 26 October 1981 version.

4.1 SOURCE ENERGY CONSUMPTION

Table 2: IAAP Source Energy Consumption (including AEC) - FY 1975 and 1979, compares energy consumption at IAAP from FY 1975, the base year for the study, with consumption during FY 1979. Fuel consumption over the period decreased by about 43 percent, though costs increased by about 60 percent. This is primarily attributed to the cessation of some specialized production as well as energy conservation measures.

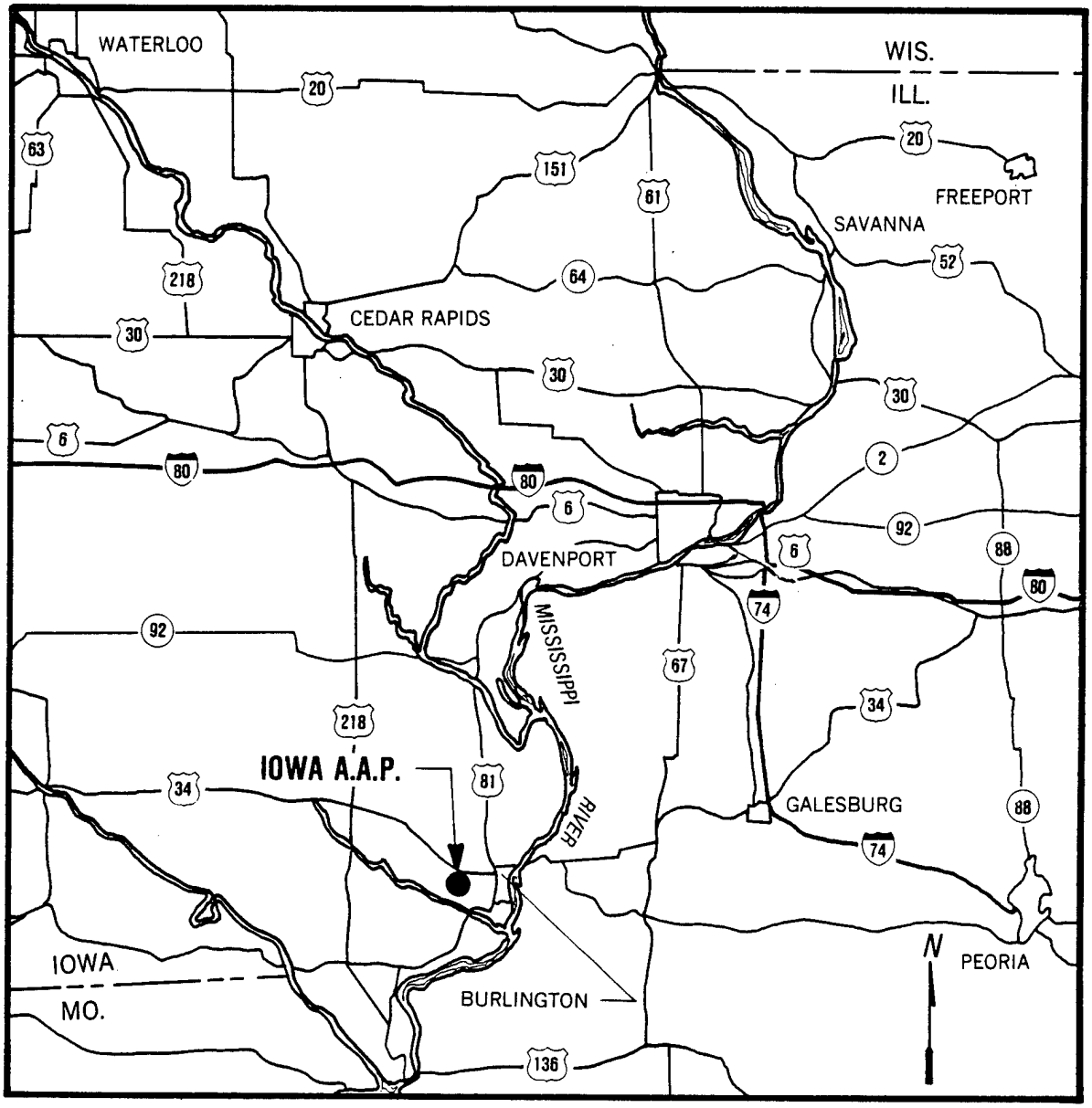

FIGURE 1
IOWA ARMY AMMUNITION PLANT LOCATION MAP

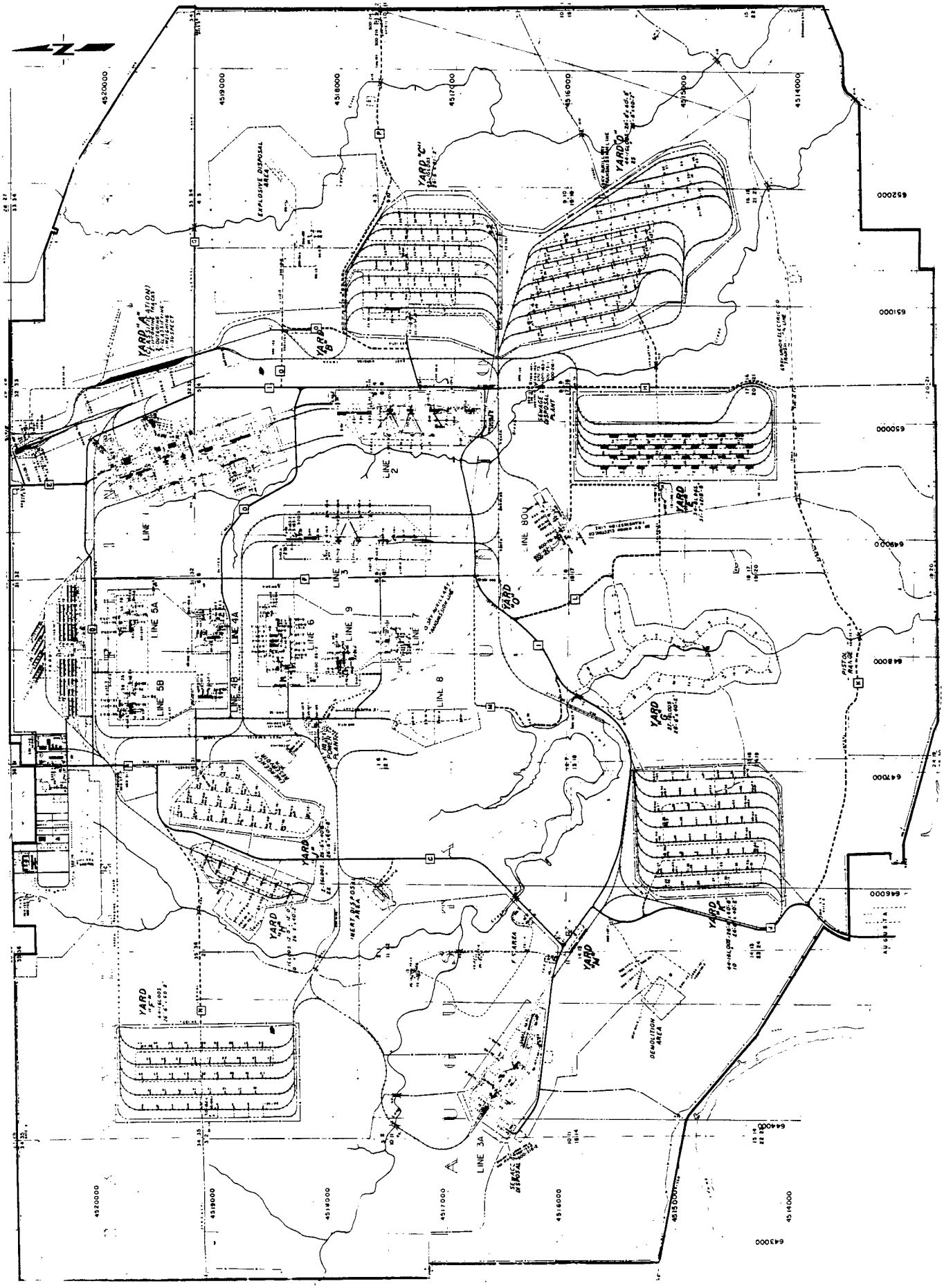

FIGURE 2
IOWA ARMY AMMUNITION PLANT GENERAL SITE MAP

TABLE 1
COMPARISON OF
ARMY FACILITIES ENERGY PLAN GOALS

	1 OCT '78	26 OCT '81
Reduce total consumption by:	25% by FY 85 50% by FY 2000	20% by FY 85 40% by FY 2000
Energy from coal and RDF	10% by FY 85	N.M.
Solar energy	1% by FY 85	N.M.
Natural gas	Eliminate use by FY 2000	N.M.
Petroleum fuels	Reduce by 75% by FY 2000	N.M.
Capability for synthetic gases	N.M.	By FY 2000
Heating oil consumption	N.M.	Reduce by 75% by FY 2000

N.M. - Not Mentioned

TABLE 2
IAAP SOURCE ENERGY CONSUMPTION (INCLUDING AEC)
FY 1975 AND 1979

Source	Cost ($000)	MBTU's Consumed (000)	Cost ($000)	MBTU's Consumed (000)
Electricity	$ 528	399	$ 486	201
Coal	307	519	0	0
Dist. Fuel Oil	76	37	311	111
Resid. Fuel Oil	160	96	1,846	849
Natural Gas	646	1,080	127	56
Totals	$1,717	2,131	$2,770	1,217

Current fuel consumption is primarily attributed to building rather than process requirements.

5.1 PROJECT EXECUTION

This energy engineering analysis was conducted in four phases:

- Field surveys and data gathering
- Analysis of projects
- Review and verification
- Preparation of Project Programming Documents

5.1.1 Field Surveys and Data Gathering

The field surveys included buildings and process surveys. The building surveys were conducted in four areas:

- Architectural - to evaluate such items as wall and roof types, and levels of insulation
- Mechanical - to evaluate heating, ventilating, and air conditioning systems
- Electrical - to evaluate lighting and building electrical systems
- Distribution - to evaluate plant utility systems

The process surveys addressed the seven process lines located at the plant.

The distribution surveys covered all plant utility systems including electrical, steam, natural gas, water, sewage, and compressed air.

The survey phase enabled the identification of energy conservation opportunities and the applicability of energy conservation measures to IAAP.

5.1.2 Analysis of Projects

After the data gathering phase it was possible to identify potential projects for analysis. These projects were analyzed for applicability to IAAP and their potential to save energy in relation to their implementation cost.

Energy conservation measures were computer-analyzed to develop energy savings and implementation costs. In addition, SAP, BCR, and ECR values were computed. These latter three values, however, are no longer needed to determine project priorities. Instead, priorities are determined by Savings Investment Ratio (SIR) using the methodology presented in the Energy Conservation Investment Program (ECIP) Guidance. dated 22 September 1982. Projects recommended for implementation in this report on the basis of ECR generally meet SIR criteria.

5.1.3 Review and Verification

IAAP personnel assisted in the selection of those projects which should be implemented and developed project priorities. All projects were reviewed and verified at the plant in consultation with IAAP personnel.

5.1.4 Preparation of Project Programming Documents

A DD Form 1391, Detailed Justification and Project Development Brochure, has been prepared for each selected ECAM project.

6.1 ENERGY CONSERVATION OPPORTUNITIES

The following energy conservation opportunities were investigated and found to be viable:

Insulation
Storm Windows
Caulking
Weatherstripping
Modify Hot Water Heater Controls
Install Shower Flow Restrictors
Reduce Ventilation Requirements
Prevent Air Stratification
Improve Window U-Value
Reduce Lighting Levels
Replace Incandescent Fixtures
Install High-Efficiency Fixtures
Night Setback Controls
Oxygen Control for Boilers
Blowdown Heat Recovery
Revise Boiler Controls
Install New Burners
Reduce Street Lighting
Insulate Steam Lines Return Condensate
Repair Compressed Air Leaks

The following conservation opportunities were studied but found not viable because of low ECR or lack of conservation opportunity at the plant:

ECM 4 - Install Storm Windows
ECM 5 - Weatherstrip Doors
ECM 6 - Install Thermostatic Radiation Valves
Insulate Exposed Concrete Floors
Install Insulated Overhead Doors in Building 500-129
Convert Building 1-61 Lower Level Air Handling System to VAV
Modify Electrical Distribution System in Line C
Reclaim Condensate in Administration Area
New Boiler for Line 800
Condensate Return for Lines 1, 2 and 3
Line 3 to Line 2 Steam Pipe Connections
Replace Boilers in Building 500-144
Replace or Improve Boilers in Buildings 1-02 and 2-02

Convert Building 1-62 to Fire Coal
Internal Strip Doors Between Unheated Ramps and Heated Buildings
Process Vacuum Shutdown in Building 1-40
Compressor Load Cycling in Line 6
Fully Enclose Ramp at Building 1-04
Insulate Condensate Piping in Building 1-05-1
Add Insulation to Line 6 Dry House
Add Insulation to Buildings 500-118 and 500-172
Line 4B Buildings Scheduled for Major Renovation
Applying Insul/Crete Below grade to Reduce Floor Slab Heat Losses
Energy Monitoring and Control System (EMCS)
Family Housing Currently Included in IAAP Insulation Projects

7.1 PROJECTS SUMMARY

7.1.1 Introduction

A complete listing of all ECAM, Increment "G" and other projects is provided in project number order. This is followed by specific categories of projects arranged in priority order according to descending ECR. A summary of project categories completes this section in Table 8: Summary of Projects.

7.1.2 Selected ECAM Projects

ECAM Projects selected by IAAP personnel at the Review and Verification Meeting are presented in Table 4: Selected ECAM Projects. Projects are separated by fiscal year and by standby or mobilization status and listed in order of descending ECR.

7.1.3 Viable Projects Not Selected for Implementation by IAAP

Table 5: Viable Projects Not Selected for Implementation by IAAP, includes those projects not selected for implementation by IAAP personnel. These projects were not selected because anticipated procedural changes at the plant would make these projects unnecessary and other projects have accomplished the same purpose. Projects are separated by fiscal year and by standby and mobilization status and listed in order of descending ECR.

7.1.4 Energy Conservation Measures Not Meeting ECAM Criteria

Those portions of ECM Nos. 2 through 8 not included in selected ECAM projects, Increment "G" projects or viable non-selected projects are summarized in Table 6: Energy Conservation Measures Not Meeting ECAM Criteria. Annual MBTU savings, CWE, TIC, and ECR data are included for the unselected portion of each ECM. A complete itemization of individual building projects from which future implementation selection could be made appears in Appendix III.

7.1.5 Increment "G" - Minor Construction, Maintenance and Repair Projects

Table 7: Increment "G" - Minor Construction, Maintenance and Repair Projects, lists qualifying projects by descending ECR.

7.1.6 Infeasible Projects

Table 8: Infeasible Projects, lists those energy conservation projects not in accordance with ECAM guidance in order of descending ECR.

7.1.7 Increment "E" - Central Boiler Plant Projects

A coal-fired, central steam plant project located in Building 500-139 has been developed for IAAP. FY 84 project cost: $16,000,000.

7.1.8 Increment "F" Projects

Increment F projects recommended for implementation will save approximately 3,040 MBTU's per year and produce a first year savings of about $10,600. These projects are listed in Table 3: Proposed Projects (Increment F).

TABLE 3

PROPOSED PROJECTS (INCREMENT F)

Project No.		Annual Energy Savings (MBTU)	First Year Savings	SIR
1	Install Strip Doors	560	$ 1,950	29.54
3	Window Reduction	129	450	2.00
2	Insulate Walls and Roofs	1,000	3,480	1.68
6	Loading Dock Door Seals	140	490	1.68
1-62-2	Steam Generating Plant Renovation	932	3,240	1.59
10-2-1	Outside Air Programmable Controller	275	960	1.00
		3,036	$10,570	

The Increment F study also included recommendations concerning the applicability of a small EMCS for selected buildings in Line 1 and an analysis of the feasibility of installing new chilling equipment in Building 1-40E. These analyses showed that a small EMCS was not viable and that local point-of-use chilling plants with one 75-ton chiller each should be installed in Buildings 1-40 and 1-61.

TABLE 4

SELECTED ECAM PROJECTS

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	Benefits ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR
	FY 84 Standby Status								
5-13	Convert Building 1-40 Air Handling System to Variable Air Volume	11,100	25	421	121	128	4.8	3.3	91.4
5-2	Insulate Buildings - Line 1	13,500	47	724	429	452	9.2	1.6	31.4
5-1	Insulate Buildings - Line 3 and Buildings 500-37-6, 500-111 and 500-143	10,700	35	524	365	384	10.4	1.4	29.3
5-3	Insulate Buildings - Line 2	11,500	38	557	433	456	11.5	1.2	26.6
6-3	Install Condensate Return System in Group 3A	4,400	38	753	233	245	6.2	3.1	18.8
7-2	Install Low Excess Air Burners in Building 3A-02	3,800	28	569	206	217	7.3	2.6	18.4
	Subtotal	55,000	211	3,548	1,787	1,882			
	FY 85 Standby Status								
5-4	Insulate Buildings - Line 6 and Administration Area	5,300	19	280	88	93	4.6	3.0	59.8
5-6	Insulate Buildings - Line 5A and 5B and Buildings 500-116 and BG-1	9,400	37	568	348	366	9.5	1.6	27.0
5-5	Insulate Buildings - Line 3A	10,000	86	1,721	470	495	5.5	3.5	21.4
	Subtotal	24,700	142	2,569	906	954			

TABLE 5

VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION BY IAAP

Project No.	Project Title	Annual MBTU Savings	CWE ($000)	TIC ($000)	SAP	BCR	ECR
	FY 84 Standby Status						
7-3	Install Low Excess Air Burners - Building 500-144	5,400	206	217	5.1	3.7	26.2
6-2	New Insulation on 150 PSIG Steam System - Line 6 to Line 800	6,100	406	427	20.4	0.7	15.0
	Subtotal	11,500	612	644			
	FY 85 Standby Status						
5-8	Insulate Buildings - Line 8 and Miscellaneous Buildings	4,000	129	136	8.0	1.9	31.3
5-7	Insulate Buildings - Line 9	5,100	280	295	14.3	1.0	18.1
	Subtotal	9,100	409	431			
	FY 85 Mobilization Status						
6-1	Replace Existing Exterior Incandescent and Mercury Vapor Lighting Fixtures with High-Pressure Sodium Fixtures	17,800	1,507	1,581	15.5	1.0	11.8

TABLE 6

ENERGY CONSERVATION MEASURES NOT MEETING ECAM CRITERIA OR FACILITY REQUIREMENTS*

ECM No.	Annual MBTU Savings	FY 84 CWE ($000)	FY 84 TIC ($000)	ECR
2	67,000	3,233	3,402	20.7
3	7,200	117	123	61.5
4	350	14	15	25.0
5	4,800	452	476	10.6
6	5,200	722	760	7.2
7	44,500	7,496	7,890	5.9
8	6,200	18	19	344

* Those portions of ECM Nos. 2 through 8 not included in selected ECAM projects, Increment "G" projects or viable non-selected projects are summarized in this table. The non-selected measures, with allowable ECR's, do not meet the requirements of the plant due to future planning, revisions in facilities use, etc.

TABLE 7

INCREMENT "G" MINOR CONSTRUCTION, MAINTENANCE AND REPAIR PROJECTS

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR	Manhours
	FY 84 Standby Status								
7-1	Install Blowdown Heat Recovery - Building 1-62	4,400	23	24	25	1.1	17.9	184	300
5-11	Reduce the Number of Lamps in Selected Buildings	1,200	5.1	9.2	9.7	1.8	9.6	131	690
5-14	Building 1-61 Night Setback and Ventilation Reduction During Unoccupied Hours	1,500	4.9	12	13	2.5	5.5	121	174
12-1	Insulate Steam Lines	1,450	4.8	15.7	16.5	3.3	4.3	92.5	344
5-16	Insulate Heated Ramps - Line 6	1,500	4.9	18	19	3.7	3.8	83.3	393
5-15	Insulate Heated Uninsulated Ramps - Line 6	5,700	19	73	77	3.9	3.6	78.4	1,112
5-12	Reduce the Number of Lamps in Other Selected Buildings	330	1.4	4.6	4.8	3.3	5.2	71.3	345
5-9	Replace Lighting Fixtures in Selected Buildings	1,300	5.5	25	27	4.6	3.8	51.4	560
12-2	Reduce Lighting - Building 1-148	870	1.6	17	18	10.4	1.7	51.1	342
12-3	Insulate Process Tank - Building 1-05-2	64	0.2	2.7	2.8	13.0	1.1	23.5	80
12-4	Insulate Soaking Bath Tank - Building 1-05-2	260	0.8	11.8	12.4	14.1	1.0	21.7	354
5-10	Replace Lighting Fixtures in Other Selected Buildings	380	1.6	27	28	16.4	1.0	14.4	590
	Subtotal	18,950	72.8	240	253				
	FY 85 Standby Status								
5-17	Insulate Firing Buildings	360	0.8	13	14	16.7	1.0	28.1	174

TABLE 8

INFEASIBLE PROJECTS

Project No.	Project Title	Annual MBTU Savings	CWE ($000)	TIC ($000)	SAP	BCR	ECR
12-5	Insulate Inert Melt Tanks - Bldg. 2-01	15	1.3	1.4	26.5	0.5	11.5
12-6	Insulate Hot Water Lines - Bldg. 3-05-2	35	3.9	4.1	34.2	0.4	9.0
7-4	Install One 60,000 Lb/Hr Boiler - Bldg. 3A-02	9,500	1,160	1,221	16.4	1.2	8.2
7-5*	Install Two 30,000 Lb/Hr Boilers - Bldg. 3A-02	9,500	1,555	1,637	21.9	0.9	6.1
	Subtotal	9,550	1,165	1,226			

* Project No. 7-5 is an alternative to Project No. 7-4, and is not included in the subtotal.

TABLE 9

SUMMARY OF PROJECTS

FY 84	Annual MBTU Savings	TIC ($000)
Selected ECAM Projects (Standby Status)	55,000	1,882
Viable Projects Not Selected (Standby Status)	11,500	644
Increment "G" Projects (Standby Status)	18,950	253
Total	85,450	2,779
Increment "E" Projects (Central Boiler Plant)	--	16,000
		18,779

FY 85		
Selected ECAM Projects (Standby Status)	24,700	954
Viable Projects Not Selected (Standby Status)	9,100	431
Viable Projects Not Selected (Mobilization Status)	17,800	1,581
Increment "G" Projects (Standby Status)	360	14
Total	51,960	2,980

INCREMENT F PROJECTS*	Annual MBTU Savings	Total Investment
Proposed Projects	3,040	$85,700

* Implementation of funded Increment F projects will be scheduled by the Facilities Engineer.

8.1 PROJECTED ENERGY TRENDS

Figure 3: Standby Status-Projected Energy Consumption, shows the projected energy consumption trend over the period FY 1975 to FY 2000 as a result of implementing projects developed by IAAP and the projects described in this report. From FY 1984 through FY 1985, when the energy projects will be implemented, energy use will decline by approximately 83,000 MBTU's, not including reductions caused by projects already planned by IAAP. Building energy use will be reduced from 586 KBTU's in FY 75 to 283 KBTU's per gross square foot per year in FY 85.

The decrease in energy use is attributed to the following factors:

- Elimination of AEC use of Line 1 - 400,000 MBTU
- Energy reduction through IAAP conservation efforts through FY 1983 - 790,000 MBTU
- Energy reduction through selected standby status ECAM projects presented in this Energy Engineering Analysis - 80,000 MBTU
- Energy reduction through proposed projects presented in the final submission of the Increment "F" report dated May, 1983 - 3,000 MBTU

A 30,000 MBTU increase in energy usage is forecast for FY 87 when Lines 5B, 9, 4A, and 4B will be activated. This increase can be offset by the implementation of viable non-selected projects and continued energy conservation efforts.

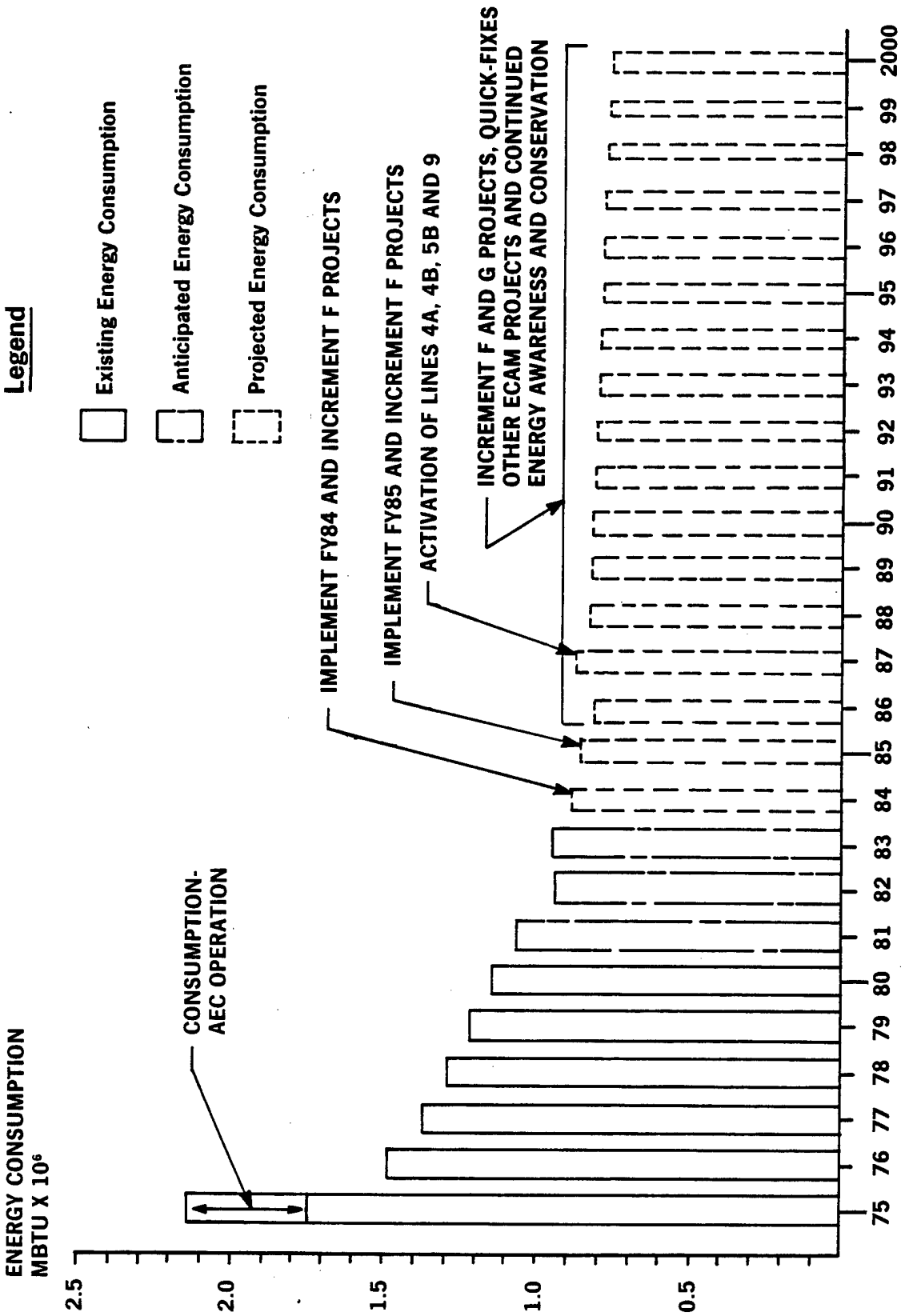

FIGURE 3

STANDBY STATUS — PROJECTED ENERGY CONSUMPTION

DEFINITION OF TERMS

BENEFICIAL OCCUPANCY DATE (BOD)

The date a facility begins to operate.

BENEFIT-TO-COST RATIO (BCR)

The dollar savings realized over the life of the project divided by the non-recurring capital investment (including design). BCR is a measure of project payback. A BCR of 1.0, for example, means that the project's initial capital investment will be recovered over its lifetime.

CURRENT WORKING ESTIMATE (CWE)

The project installation cost escalated to the year the project is programmed for implementation. Installation costs are non-recurring and include all labor and material, contractor costs, bond, contingency, SIOH, and escalation. Design costs are not included and must be added to the CWE to develop the total project cost.

ENERGY-TO-COST RATIO (ECR)

The MBTU's per year saved divided by the non-recurring capital investment (excluding design). ECR is a measure of the amount of energy savings per thousand dollars of required capital investment.

SAVINGS INVESTMENT RATIO (SIR)

The total net discounted savings divided by the total investment, in accordance with ECIP Guidance, dated 6 August 1982.

SIMPLE AMORTIZATION PERIOD (SAP)

The project capital investment divided by the yearly savings. This yields the period of time required to recover the initial capital investment.

TOTAL INSTALLED COST (TIC)

The sum of the CWE and the design costs.